Real Size And Membership Richness Determination Of High-Latitude Open Clusters

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Abstract. We use proper motion measurements to determine the real size and membership richness of a sample of open clusters located at high galactic latitudes ($40 \leq |b| \leq 90$).

Key words: astrometry - clusters - luminosity function.

1. INTRODUCTION

USNO-B1.0 of Monet et al. (2003) is a spatially unlimited catalog that presents positions, proper motions, and magnitudes in various optical passbands. The data were obtained from scans of Schmidt plates taken for the various sky surveys during the last 50 years. USNO-B is believed to provide all-sky coverage, completeness down to $V = 21$ mag. It is noted that, based on the proper motion measurements, stars with large proper motions are likely to be foreground stars instead of cluster members. Background stars cannot readily be distinguished from members by proper motions. Nonetheless, identifying foreground stars is useful in cleaning up the color-magnitude diagrams and estimating the amount of field star contamination. So, USNO-B is a very useful catalog, which gives us an opportunity to distinguish between the members and field and background stars. On the other hand, the

use of proper-motion-based membership for a very distant cluster cannot be regarded as a good idea. However, in particular cases it can work, for clusters located at high latitude above the galactic plane, hence contaminated by relatively nearby stars only, where far background and foreground stars become rare. This point however requires validation and detailed discussion due to the peculiarities of the USNO-B catalog, which is the main idea of the present work.

On this respect, open clusters located at high galactic latitudes ($40 \leq |b| \leq 90$) have been nominated from WEBDA site [1] (16 clusters; 10 below and 6 above the galactic plane). Those clusters are contaminated by relatively nearby stars.

Because USNO-B catalog demonstrates a pronounced excess of zero-proper-motion objects, it is found suitable enough for the aim of this paper. So, after removing the contaminated nearby stars, we can determine the genuine size of each cluster of our sample regardless on the available photometry. Applying the completeness correction for each cluster, the membership determination can be counted.

2. ON THE PRESENT WORK

Using USNO-B1.0 catalog of Monet et al. (2003), we can determine the genuine borders of the clusters under investigation. For this purpose, the data have been obtained at a preliminary radius of about 20 arcmin from the cluster center. For all the clusters of our sample, all stars with nonzero proper motions and those distributed over the field with no concentration around the cluster center have been removed.

Within concentric shells in equal incremental steps of 0.5 arcmin from the cluster center, stellar density is performed out to the preliminary radius. The real cluster radius is defined at the point that covers the cluster area and reaches enough stability in the density of the background, i.e. the difference between the observed density profile and the background one is almost equal to zero (see Tadross 2005). At that pointed radius, the data incompleteness is evaluated and removed down to a specific B2 magnitude (the second blue magnitude of USNO-B catalog) with completeness level more than 60%. At this value the cluster data can be cut-off and then the membership can be

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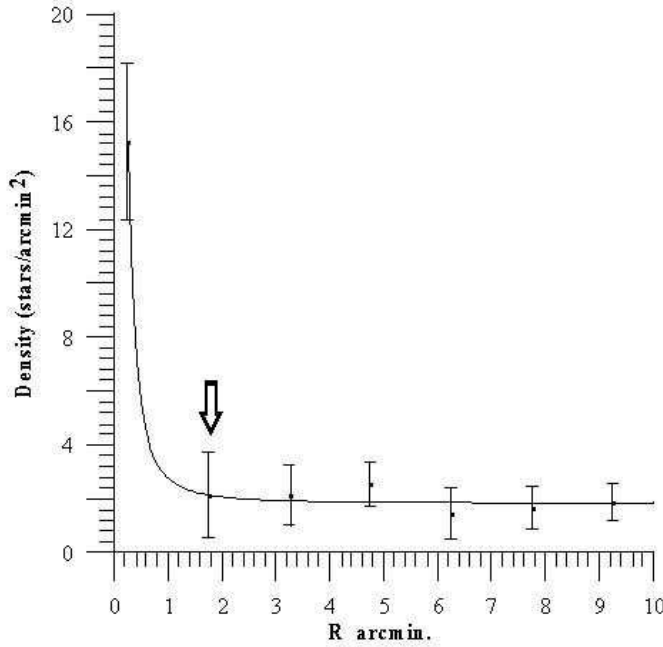
[1] $http://www.univie.ac.at/webda$

Figure 1: An example for estimating the true radius of NGC 1498 using the projected density distribution. The lengths of the error-bars denote errors resulting from sampling statistics, in accordance with Poisson distribution $(1/N)^{1/2}$, where N is the number of stars used in the density estimation at that point. The arrow represents the point at which the radius of the cluster is obtained.

counted (Sanner et al. 1999). An example, for estimating the true radius and the completeness limit of the membership for NGC 1498 is shown in Figs. 1 and 2.

3. CONCLUSIONS

Following the above procedure, the real size, completeness limit, and membership richness of all the clusters of our sample have been determined and listed in Table 1. It is noted that most of the clusters in the present work have larger diameters and contain more members than those obtained in the literature. For the sake of comparison, the relation between the resultant
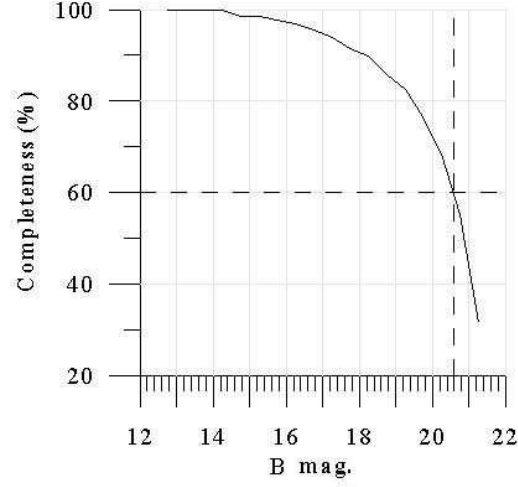
Figure 2: An example for estimating the completeness limit at which the membership of NGC 1498 has been counted. Horizontal and vertical dashed lines represent this limit $\geq 60\%$ at 20.60 mag.
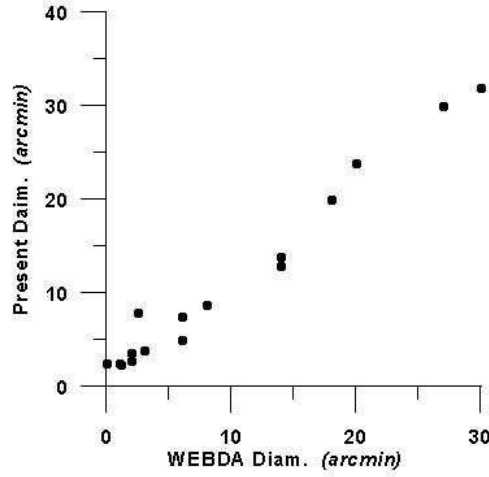

Figure 3: Comparison between the resultant diameters and those given in WEBDA. The correlation coefficient is found to be 0.98.
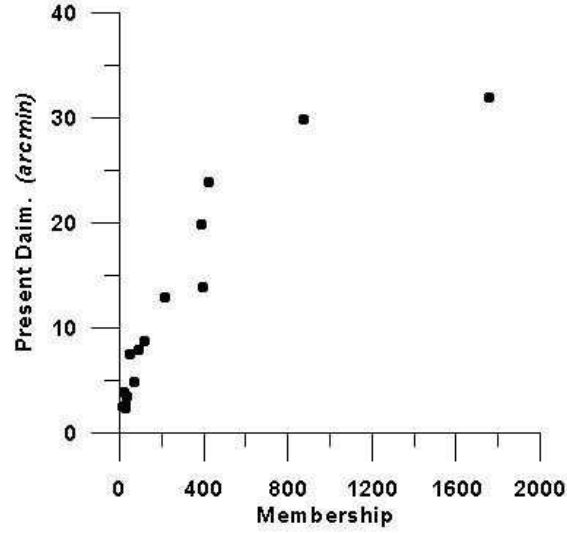
Figure 4: The relation between the resultant diameters and membership richness. It is noted that the number increases with diameter in proportional way; see the text.

diameters and those given in WEBDA is supposed to be linear with correlation coefficient of 0.98, as shown in Fig. 3. On the other hand, the resultant diameters are found related to the richness in proportional way as shown in Fig. 4. This point was declared before in previous studies (see Tadross et al. 2002, and the references therein).

Table 1: The main parameters of 16 clusters of our sample with completeness limit, genuine diameters and membership richness.

Cluster	α 2000 h m s	δ 2000 ° ′ ″	l 2000 deg	b 2000 deg	C.L.	Diam. arcmin	Mem.
Upgren 1	12 35 00	+36 18 00	142.740	80.188	20.5	20	382
Chereul 1	14 29 04	+55 23 30	97.639	56.679	20.9	2.6	23
NGC 3231	10 26 58	+66 48 42	141.924	44.653	20.6	8	82
Dol-Dzim 5	16 27 24	+38 04 00	60.866	43.875	20.5	30	870
NGC 5385	13 52 27	+76 10 24	118.197	40.389	21	8.8	115
Dol-Dzim 6	16 45 24	+38 21 00	61.583	40.368	20.3	5	62
AM 0430-392	04 32 24	-39 17 36	242.616	-42.958	20.9	2.8	25
NGC 1498	04 00 18	-12 00 54	203.623	-43.330	20.6	3.6	27
ESO 236-07	21 21 28	-51 48 42	345.827	-43.901	20.5	32	1750
NGC 7772	23 51 46	+16 14 48	102.740	-44.273	20.8	4	18
NGC 7134	21 48 55	-12 58 24	41.980	-45.141	20.4	2.6	11
NGC 305	00 56 20	+12 04 00	124.825	-50.787	20.6	7.6	40
NGC 1252	03 10 49	-57 46 00	274.084	-50.831	20.7	14	390
Whiting 1	02 02 57	-03 15 10	161.618	-60.636	20.2	2.4	25
ESO 245-09	01 53 43	-45 57 12	273.762	-67.488	21	13	210
NGC 7826	00 05 17	-20 41 30	61.875	-77.653	20.6	24	415

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